MODULAR MULTI-MEDIA COMMUNICATION MANAGEMENT SYSTEM WITH AN INTEGRATED SERVICE FOR WIDE AREA NETWORK WIRELESS TELEPHONES

Cross Reference to Related Applications

The present application is a continuation in part of United States Patent Application 09/961,532 titled Teledata Space and Docking Station with Modular and Integrated Display filed on September 24, 2001 the contents of such patent application is incorporated herein.

Technical Field

The present invention relates generally to managing multi-media communications, and more particularly to a modular system for integrating and coordinating a subscriber's communication needs.

Background of the Invention

In today's fast paced business world, it is common for a person to rely on a combination of communication devices, such as: desk top telephones, mobile (local area network or cordless) telephones, cellular (wide are network) telephones, fax machines, pagers, and the like, as well as enhanced communication services, such as: voice mail, e-mail, text messaging and the like to accommodate their communication needs.

In an office environment, desk top telephone service, voice mail service, and fax service is typically provided by a private telephone communication system. A contemporary private telephone communication system consists of a switching network, a plurality of desk top telephones, and a voice mail server. The voice mail server is typically coupled to the switching network using a proprietary interface. Each desk top telephone and fax machine is coupled to the switching network by an extension line that consists of twisted pair conductors that are terminated by a telephone jack in the office. Communication between the desk top telephone and the switching network over each extension line utilizes either proprietary digital signaling or plain old telephone service (POTS) signaling. The switching network is further coupled to the public switched telephone network (PSTN) using trunk lines that are connected to a central office switch that is typically managed by the local telephone service provider. The switching network controls calls between

extensions and between an extension and a remote destination via a trunk line coupled to the PSTN. The switching network also routes calls to the voice mail server when an extension remains unanswered, is busy, or is otherwise programmed to route calls to voice mail.

In a mobile environment, telephone service is typically provided by a wide area wireless telephone service provider such as a cellular telephone service provider or a PCS service provider. Such a system consists of one or more central controllers that interface telephone calls with the PSTN. A backbone wide area network couples the central controllers to a plurality of transceiver towers and telephone calls are linked between a transceiver tower and a mobile wide area network wireless telephone handset using electromagnetic signals.

A problem associated with wide area network wireless telephone systems is that the quality of service is poor compared to traditional wired telephone networks. As such, a typical person will utilize both a desk top telephone and a wide area network wireless telephone for conducting business.

A problem associated with using both systems to transact business is that there is a lack of integration and coordination between the services. While a person is at his or her desk, he or she will typically used the private telephone communication system rather than the wide area network wireless telephone for improved quality of services. However, the person will still need to monitor the wide area network wireless telephone for incoming calls, and, if an incoming call is received, the person may proceed with the call albeit the inferior quality of service rather than terminating the call and re-initiating using the private telephone network.

This problem can be eliminated, in theory, by vigilant use of the wide area wireless telephone service provider's call forwarding system. Typically the wireless telephone service provider's switching network will include one or more controllers (or switches) that include call forwarding functionality. In operation, a person may call into the controller using either the wireless telephone or a PSTN telephone and enter a command to the controller to initiate call forwarding to a designated telephone number. The command may be entered using the telephone buttons to coupled to the controller a sequence of DTMF tones to activate call forwarding to

the designated telephone number. Once activated, the controller will route calls destined for the mobile telephone to the designated telephone number. Similarly, the person may call into the controller and enter a command using the buttons to deactivate call forwarding.

Vigilent use of call forwarding may assure that incoming calls to the wide area network wireless telephone are forwarded, or funneled, to a the desk top telephone. However, such forwarding schemes are time consuming to utilize.

What is needed is a multi media communication management system that provides for automated forwarding of a wide are network telephone's incoming calls a station at which a subscriber associated with the wide area network wireless telephone is currently located.

Summary of the Invention

The present multi-media communication management system comprises a controller that interfaces with a plurality of communication space stations and with one or more communication medium service providers. Each communication space station may be coupled to a wide area network mobile telephone served by a wide area network service provider. The multi-media communication management system communicates with a wide area network controller through the service provider medium and automatically provides instructions to the wide area network controller to forward telephone calls that are directed to the mobile telephone to the system controller upon the mobile telephone being coupled to a communication space station.

The controller translates multi-media communications received from a multi-media service provider into the protocols required for use by the space station communication devices as well as any conventional telephone stations that may be coupled to the controller. The communication and control signaling between the controller and the communication space station may be wireless in nature with the communication space station being powered by an internal battery and/or connection to a local source of conventional line voltage.

The communication space station is modular. Modular docking interfaces may be used to couple the communication space station to portable subscriber

devices that include a wide area network wireless telephone. Upon detecting that a wireless telephone has been coupled to the communication space station, the multi-media communication management system communicates with the wide area network service provider controller through the service provider medium and automatically provides the commands to the wide area network service provider controller to forward telephone calls that are directed to the wireless telephone to the system controller.

The system controller further records dynamic information relating each subscriber device to the communication space station that is serving the subscriber device for communication and control signaling. This enables the controller to receive communication signaling, representing the forwarded call, for a subscriber and translate and route communication signaling to the communication space station serving the subscriber device associated with the subscriber.

For a better understanding of the present invention, together with other and further aspects thereof, reference is made to the following description, taken in conjunction with the accompanying drawings, and its scope will be pointed out in the appended clams.

Brief Description of the Drawings

Figure 1 is a block diagram view of a modular multi-media communication management system in accordance with one embodiment of the present invention;

Figure 2 is a perspective exploded view of a modular communication space station in accordance with one embodiment of the present invention;

Figure 3 is a block diagram of a communication space station in accordance with one embodiment of the present invention;

Figure 4 is a block diagram of a multi-media communication management system controller in accordance with one embodiment of the present invention;

Figure 5 is a block diagram of a subscriber data assistant in accordance with one embodiment of the present invention;

Figure 6 is a block diagram of a wide area network communication device in accordance with one embodiment of the present invention;

Figure 7 is a block diagram of a wireless dialog handset in accordance with

one embodiment of the present invention;

Figure 8a shows a table diagram representing an exemplary state of operation of a communication management system in accordance with one embodiment of the present invention;

Figure 8b shows a table diagram representing an exemplary state of operation of a communication management system in accordance with one embodiment of the present invention;

Figure 8c shows a table diagram representing an exemplary state of operation of a communication management system in accordance with one embodiment of the present invention;

Figure 8d shows a table diagram representing an exemplary state of operation of a communication management system in accordance with one embodiment of the present invention;

Figure 8e shows a table diagram representing an exemplary state of operation of a communication management system in accordance with one embodiment of the present invention;

Figure 9 shows table diagrams representing exemplary states of operation of a subscriber station accordance with one embodiment of the present invention;

Figure 10a shows table diagrams representing exemplary states of operation of a subscriber station accordance with one embodiment of the present invention;

Figure 10b shows table diagrams representing exemplary states of operation of a subscriber station accordance with one embodiment of the present invention;

Figure 11 shows a flow chart representing exemplary operation of a packet voice gateway in accordance with one embodiment of the present invention;

Figure 12 shows a location table in accordance with one embodiment of the present invention; and

Figure 13 shows a call forward file in accordance with one embodiment of the present invention.

Description of the Preferred Embodiments

The present invention is now described in detail with reference to the drawings. In the drawings, each element with a reference number is similar to

other elements with the same reference number independent of any letter designation following the reference number. In the text, a reference number with a specific letter designation following the reference number refers to the specific element with the number and letter designation and a reference number without a specific letter designation refers to all elements with the same reference number independent of any letter designation following the reference number in the drawings. A reference number followed by a "prime" symbol or a "double-prime" symbol represent an element that is a species embodiment of the more generic element designated by the reference number without a "prime" or "double-prime" designation.

It should also be appreciated that many of the elements discussed in this specification may be implemented in hardware circuit(s), a processor executing software code, or a combination of a hardware circuit and a processor executing code. As such, the term circuit as used throughout this specification is intended to encompass a hardware circuit (whether discrete elements or an integrated circuit block), a processor executing code, or a combination of a hardware circuit and a processor executing code, or other combinations of the above known to those skilled in the art.

Referring to Figure 1, an exemplary architecture of the multi-media communication management system 10 of the present invention is shown. The multi-media communication management system 10 includes a control unit 12 that is coupled with a plurality of local communication devices 20 over a wireless local area network 22 (or by a wired network connection 23 to the backbone wired network of the wireless local area network 22). The local communication devices 20 may include: subscriber stations 24 (communication space stations 24), wireless dialog handsets 26, traditional telephone handsets 28, traditional fax machines 30 (both coupled through communication space station 24), traditional computer systems 32, network printers 46, and various network appliances 34.

Each communication space station 24 may serve one of a plurality of subscriber devices 50 that may include a subscriber data assistant 86 and a wide area network wireless telephone 88. Because each subscriber device 50 may be

of a different size and shape than other subscriber devices, a docking interface 58 sized to the particular subscriber device 50 may be used to couple the subscriber device to the communication space station 24.

In operation, the control unit 12 integrates and manages multi-media communication among the local communication devices 20 and between each local communication device 20 and a remote service provider (not shown) over the service provider's multi-media communication medium 18. More specifically, the control unit 12 translates received multi-media communication signals from the multi-media communication medium 18 (or a source local device 20) to the protocols required for use by the destination local communication device 20 (or the multi-media communication medium 18).

The control unit 12 includes a multi-media communication service provider bay 14 which operatively couples one of a plurality of communication medium modules 16a - 16d to the control unit 12. Each communication medium module 16a - 16d is configured to interface with a service provider's multi-media communication medium 18a - 18d. For purposes of illustration, communication module 16(a) may be a cable modem module for communicating over coaxial cable 36 with a multi-media communication service provider such as a local cable company, communication module 16(b) may be a wide area network radio for communication over a wireless spectrum channel 38 with a wide area wireless multi-media communication service provider such as an analog or digital cellular/PCS telephone service provider, communication module 16c may be a customer service unit (CSU) for communication over a T1 line 40 with a multi-media communication provider such as a local telephone service provider, and communication module 16d may be an optical modem for communication over a fiber channel 44 with a fiber optic multi-media communication service provider. It should be appreciated that the examples of communication modules 16a-16d are for illustrative purposes only and it is recognized that multi-media communication services may be provided by other service providers utilizing other communication technologies such as satellite RF or other. For purposes of this invention, a communication module 16 includes circuitry for interfacing between the control unit

12 and a selected multi-media communication service provider. The control unit 12 further comprises a circuit switched provider bay 25 which operatively couples one or more public switched telephone network (PSTN) channels 42.

Communication Space Station

Referring to Figure 2, a perspective view of an exemplary communication space station 24 is shown. The communication space station 24 includes a platform unit 52 that operatively couples to the control unit 12 via either a wireless communication link between a platform unit network circuit 96 and the wireless network 22 or a direct network connection 23 between the platform unit 52 and the backbone network of the wireless network 22.

A plurality of functional modules 54, 56, 58, and 60 may be coupled to the platform unit 52 to form an integrated multi-media communication platform. The platform unit 52 includes a subscriber interface docking platform 64 for coupling and optionally supporting one of a plurality of modular subscriber interface units 60 to the platform unit 52. The modular subscriber interface unit 60a may include a plurality of buttons 68 in an arrangement similar to a typical telephone key pad to provide for subscriber input in a manner similar to that of a traditional telephone handset. The modular subscriber interface 60b may include a liquid crystal touch panel display 72 to provide for subscriber input through virtual buttons visible thereon.

The platform unit 52 further includes a first function specific docking platform 74a and a second function specific docking platform 74b, each of which couples to a plurality of function specific modules, such as function specific modules 54 and 56. The first function specific docking platform 74a is a shallow platform for coupling to function specific modules, such as function specific module 54, that primarily comprise function specific buttons or other circuits that may be placed within a thin module. The second function specific docking platform 74b is a larger platform for coupling to function specific modules, such as function specific module 56, with more complex internal circuits requiring the additional size. In the exemplary embodiment, the function specific module 54 may include subscriber interface buttons configured for enhancing dialog communication through the

communication space station 24 such as an audio message control 76 for single button access to audio message files and dialog management controls 86 for single button control of enhanced dialog management functions. The function specific module 56 may include circuits configured for enhancing data communication through the communication space station 24 such as an electronic message control 78 for single button access to subscriber electronic messages, a print control 80 for single button initiation of the printing of a subscriber electronic message file, and a data networking port 84.

The platform unit 52 further includes a docking bay 62 into which a modular docking interface 58 may be secured and operatively coupled to the platform unit 52. The modular docking interface 58 supports one of a plurality of modular subscriber devices 50 within a subscriber device interface bay 66 and provides for operatively coupling the modular subscriber device 50 to the platform unit 52. The modular docking interface further includes a plurality of control buttons 92 for single button selection of functions indicated on a display 90 on the subscriber device 50. Exemplary configurations for the modular subscriber device 50 include a subscriber data assistant 86, a subscriber wide area network communication device 88, and the wireless LAN dialog handset 26, each of which is discussed in more detail herein. While operatively coupled to the platform unit 52, the subscriber device 50 becomes an integral part of the subscriber interface of the communication space station 24. A liquid crystal display 90 on the subscriber device 50 may function to display multi-media communication management information under control of the platform unit 52 and the control unit 12. Further, programmable subscriber controls 92 positioned adjacent to the subscriber device 50 may be configured to activate platform unit 52 and control unit 12 functions in accordance with the contents of the display 90 adjacent to the controls 92.

The platform unit 52 may further include one or more of the following elements: a handset 98 similar to a traditional telephone handset to provide a subscriber voice interface, a speaker 100 and a microphone 102 to provide a hands-free subscriber voice interface, a modular battery pack 70 (which fits within a battery pack bay that is not shown) for operating power when the communication

space station 24 is uncoupled from a line voltage, an on/off hook control button (or switch), and a help control button 105, a WAN control button 104, and a directory control button 107, for single button selection of certain functions such as a help function, a wide area network communication function, display of a contact directory respectively.

Figure 3 shows a block diagram of the communication space station 24. The platform unit 52 includes a controller 112 operating a packet voice application 113, a CSS application 115, and applicable drivers for a plurality of peripheral controllers. The controller 112 is coupled to a local bus 116 that interconnects the application controller 112 with each of the plurality of peripheral controllers that include a wireless module 94, a power management controller 120, a communication controller 122, a network switch controller 124, a key switch controller 126, a touch panel controller 128, a plain old telephone service (POTS) converter 146, and a voice communication system 130.

The wireless module 94 operatively couples the platform unit 52 with the control unit 12 over the wireless LAN 22 (both of Figure 1). The power management controller 120 selectively receives input power from the battery pack 70 or external line voltage 134. The power management controller 120 includes appropriate circuits for converting the input power voltage to appropriate operating power required by each component of the communication space station 24. Additionally, the power management controller 120 includes appropriate circuits for charging the battery pack 70 when the platform unit 52 is coupled to the line voltage 134 and generating appropriate power for operating and/or charging the modular docking interface 58 and the modular subscriber device 50 when coupled to the platform unit 52.

The communication controller 122 operatively couples the modular docking interface 58 and the modular subscriber device 50 to the controller 112 such that the platform 52 can exchange data with the modular subscriber device 50. In the exemplary embodiment, the communication controller is a serial communication controller that enables the serial exchange of data with a compatible serial communication controller within the modular subscriber device 50 over a physical

medium. Exemplary physical mediums include hardwired contacts, an infrared transmission, and RF transmission, however other physical mediums are envisioned and the selection of a physical medium is not critical to this invention.

The network switch controller 124 provides a network data port circuit which enables the controller 112 to communication with another network computing circuit over a network interface. The network switch controller 124 is coupled to a bus port 135 within the function specific docking platform 74b for coupling to a mating port 148 on the function specific module 56.

The key switch (e.g. button) controller 126 is coupled to: a connector 136a which in turn is coupled to a mating connector on the modular subscriber interface unit 60a (Figure 2) for interconnecting the buttons 68 to the key switch controller 126; a connector 136b which in turn is coupled to a mating connector 142 on the function specific module 54 for interconnecting the buttons 76 and 86 to the key switch controller 126; the bus port 135 which in turn is coupled to a mating port 148 on the function specific module 56 for interconnecting the buttons 78 and 80 to the key switch controller 126; and the help control button 105, the WAN control button 104, the directory button 107, and the on/off hook button (or switch) 109. In the exemplary embodiment, the key switch controller 126 may drive row and column signals to the various buttons and, upon detecting a short between a row and a column (e.g. button activation) reports the button activation to the controller 112 over the bus 116.

The touch panel controller 128 is coupled to a connector 144 which in turn is coupled to a mating connector on the modular subscriber interface unit 60b (Figure 2) for interconnecting the touch panel 72 to the touch panel controller 128. In the exemplary embodiment, the touch panel controller 128 may include a separate display control circuit compatible with the resolution and color depth of the display of touch panel 72 and a separate touch panel control circuit for detecting subscriber contact with the touch panel 72.

The voice system 130 generates analog audio signals for driving the speaker 100 (or the speaker in the handset 98 of Figure 2) and detects input form the microphone 102 (or the microphone in the handset 98) under the control the

packet voice application 113 operated by the controller 112.

The POTS converter circuit 146 provides a standard POTS port signal (e.g. tip and ring) for operation of a traditional telephone or a traditional fax machine coupled to a POTS port 82 on the function specific module 56. In operation the POTS converter 146 circuit interfaces between the POTS signal and the application controller 112.

Control Unit

Figure 4 shows a block diagram of the control unit 12 in accordance with an exemplary embodiment of the present invention. As discussed previously, the control unit 12 includes a multi media communication service provider bay 14 which operatively couples one of a plurality of communication medium modules 16 to the control unit 12 for providing an interface to a service provider's multi-media communication medium. The control unit 12 further includes a local area network management system 214, a voice converter circuit 218, a voice server 226, a packet voice gateway 232, a session control server 230, messaging client 228, and a subscriber contact directory database 234.

The local area network management system 214 manages the communication of data between the control unit 12 and each of the local communication devices 20 (Figure 1). The local area network management system 226 may include an address server 220 for assigning a network address (from a block of available network addresses) to each local communication device 20 upon the local communication device subscribing to the wireless network 22 and requesting a network address. The local area network management system 214 may also include a proxy server 222 for communicating with remote devices via the service provider multi-media communication medium 18 on behalf of each of the local communication devices 20. A port control circuit 216 may interconnect the local area network management system 214 to each of the wireless network 22, the packet voice gateway 232, the session control server 230, and the messaging client 228 over standard network port connections. The messaging client 228 provides for authenticating a subscriber to a remote messaging server (not shown) coupled to the service provider multi-media communication medium 18 and copying

a plurality of subscriber messages from such messaging server.

The session control server 230 operates the protocols for sending multi-media content messages and control messages to each local communication device 20 over the wireless local area network 22. In the exemplary embodiment, the communications between the session control server 230 and each local communication device occurs using tagged messages. The tag for each message identifies the content of the message to the recipient local communication device 20. The packet voice gateway 232 provides real time voice communications between multiple local communication devices 20 and provide real time voice communications between a local communication device 20 and a remote voice communication device over either the multi-media communication service provider medium 14 or the circuit switched channel 42.

The voice converter 218 functions to convert audio signals compatible with the circuit switched channel 42 to packet voice signals compatible with the voice server 226 and the packet voice gateway 232 and, in reverse, functions to convert packet voice signals to audio signals compatible with the circuit switched channel 42. Further, the voice converter 218 functions to convert a coded extension number (e.g. DID signal) that may be included within audio session signaling through the PSTN interface 25 to a digital format compatible with the packet voice gateway 232.

Referring briefly to Figure 11, the packet voice gateway 232 may receive audio session signal, at step 500, from an originating device that may be any of the communication space stations 24, an originating device coupled to the service provider medium 14, or an originating device coupled to the circuit switched channel 42 (via the voice converter 218). The audio session signal indicates the origination of an incoming communication session to a designated destination served by the multi-media communication management system 10 and, as such, includes a subscriber identifier.

At step 502, the packet voice gateway 232 identifies a subscriber device, such as subscriber device 50, that is associated with the subscriber identifier by retrieving a corresponding data entry from a current network address table 233.

Referring briefly to Figure 12, the current network location table 233 may comprise a plurality of records 235, each of which is associated with a unique subscriber identifier 237. Associated with each unique subscriber identifier 237 is a subscriber name 239, a subscriber device ID 241, and the network address 243 of the subscriber station 24 that is serving the subscriber device. If the subscriber device is not served by any subscriber station 24, then the current network address field 243 will so indicate.

In the exemplary embodiment, the subscriber identifier 237 may be a 4 digit number that corresponds to the last four digits of a unique PSTN telephone number. As such, standard PSTN DID indicator protocols may be used to provide the subscriber identifier 237 when the audio session signal is provided to the packet voice gateway 232 through the circuit switched channel 42. However, it should be appreciated that the subscriber identifier 237 may be any alpha-numeric sequence, such as a subscriber name 238, and a separate field may be used to associate the subscriber identifier 237 to a DID indicator compliant number.

Returning to Figure 11, the packet voice gateway 232 at step 504 determines whether the subscriber device 50 is served by a communication space station 24. If not, processing advances to step 516 where the originating device is provided with access to a voice mail functionality which is discussed herein. If the subscriber device 50 is associated with a communication space station 24, the packet voice gateway 232 at step 506 identifies the network address of such communication space station 24. Then at step 508, the packet voice gateway 232 determines whether a communication channel is already open with such communication space station 24. If yes, the packet voice gateway 232 would again provide voice mail functionality, since the communication space station 24 is busy.

If there is not already a communication channel open, the packet voice gateway 232 provides an incoming call communication signal to the communication space station 24 at step 510.

If the communication space station responds to the incoming call communication signal, at step 512, which would indicate that the subscriber is able to participate in a voice communication session, the packet voice gateway 232

establishes a communication session channel with the originating device, establishes a communication session channel with the communication space station 24, and relays audio data between the two for the duration of the audio communication session at step 514.

However, if at step 512 the communication space station 24 does not respond to the incoming call communication signal, then the packet voice gateway 232 provides a voice mail functionality to the originating device at step 516.

Returning to Figure 4, the voice mail functionality is provided by a voice server module 226. The voice server module 226 generates audio prompts for providing a voice interface to accept an audio message from the originating device for the subscriber, store the message as a digital file, and send the digital file to the remote messaging server associated with the subscriber.

In the exemplary embodiment, the packet voice gateway 232 provides a voice mail origination communication signal to the voice server module 226 and, upon the voice server module 226 responding to the voice mail origination communication signal, the packet voice gateway 232 establishes a communication session channel with the originating device, establishes a communication session channel with the voice server module 226, and relays audio data between the two for the duration needed for accepting the audio message.

The subscriber contact directory database 234 includes a contact directory for each of a plurality of subscribers. Within each contact directory are a plurality of contact files that include basic information associated with the contact, such as company name, telephone number, e-mail address, mailing address, fax number and other relevant information. The contact directory provides destination information which may be used by the packet voice gateway 232 and the session control server 230 for establishing communication channels from a communication space station 24 to a selected contact.

Referring briefly to Figure 13 in conjunction with Figure 4, the call forward file 245 associates each of a plurality of wide area network wireless telephones 88, by ID code 518, to the wireless telephone service provider's network controller 522 that provides call forwarding services to the wide area network wireless telephone

88. Because wireless telephone service providers permit access to the controller for initiating and/or terminating call forwarding by dialing a specific telephone number, the network controller 522 may be identified by the telephone number that provides such access. However, it is also envisioned that wide area wireless service providers may at some time couple the controller to the Internet such that the command to activate call forwarding to a designated telephone number and the command to deactivate call forwarding may be provided to the controller by opening an IP session with the controller over the Internet. In which case, the call forward command and the deactivate call forward command may be a sequence of ASCII characters, XML messages, or predetermined communication signals. To enable operation of the present invention with such a system, the network controller 522 may be identified by its Internet address and port number designated for accepting requests to open call forwarding sessions.

Also associated with the ID code 518 are: the call forward command 524, the call forward deactivate command 526, and a designated telephone number 520 that will be provided to the network controller 522 such that the network controller 522 may forward calls to the designated telephone number 520. The designated telephone number 520 may include an area code and prefix that provides for the forwarded call to be routed through the multi-media service provider's communication medium to the controller 22 and may include a DID identifier which corresponds to the subscriber identification 237 (Figure 12) of the subscriber associated with the wide area network wireless telephone 88 such that the controller may route the incoming call to the subscriber station 24 that is then currently serving the wide area network wireless telephone 88 as previously discussed.

Subscriber Data Assistant

Turning to Figure 5, exemplary structure of a subscriber data assistant 86 is shown. The subscriber data assistant 86 includes a controller 160 operating a CSS client application 174, a subscriber contact directory application 178, and applicable drivers 176 for a plurality of peripheral controllers. The controller 160 is interconnected to the plurality of peripheral controllers by an internal bus 162.

Because of the small size and the portability of the subscriber data assistant 86, the touch panel 90 provides the primary subscriber interface. The touch panel 90 is controlled by a display controller 164 and a touch panel controller 166. The display controller 164 drives the liquid crystal display of touch panel 90 using signals compatible with the resolution and color depth of the display 90. The touch panel controller 166 detects user activation of the touch panel 90.

A communication controller 168 is also coupled to the bus 162 and operates under control of the application controller 160. In the exemplary embodiment, the communication controller 168 is a serial communication controller that is compatible with the communication controller 122 of the platform unit 52 (both of Figure 3) such that data communication may occur between the platform unit 52 and the subscriber data assistant 86 when the subscriber data assistant 86 is operatively coupled to the platform unit 52.

A power management circuit 170 selectively receives input power from a battery pack 172 or from the power management circuit 120 in the platform unit 52. The power management circuit 170 includes appropriate circuits for converting the input power voltage to appropriate operating power required by each component of the subscriber data assistant 86. Additionally, the power management circuit 170 includes appropriate circuits for managing charging of the battery pack 172 when subscriber data assistant is coupled to the platform unit 52.

The CSS client application 174 provides for displaying multi-media communication management information under control the platform unit 52 when coupled to the platform unit 52. In the exemplary embodiment the CSS client application 174 receives content messages and control messages from the platform unit 52 in the form of tagged messages. After receipt of the tagged messages, the CSS client application 174 builds a display document to display the communication management information represented by tagged content messages in accordance with display layout control messages that are compatible with the size, resolution, and color depth of the touch panel display 90. The display document is then displayed on the touch panel display 90.

The subscriber contact directory application 178 maintains a contact

directory file for each of a plurality of subscriber contacts. The application 178 also may permit the subscriber to add contact information and edit contact information through the touch panel 90 when the subscriber data assistant 86 is uncoupled from a communication space station 24.

It should be appreciated that in additional to operating the drivers 176, the CSS client application 174, and the subscriber contact directory application 178, the controller 160 may optionally operate any of the other software applications that are commercially available for portable data assistants (PDAs). While operation of such PDA applications may be useful to the subscriber, it is not critical to the operation of the present invention.

Subscriber Wide Area Network Wireless Telephone

Turning to Figure 6, exemplary structure of a subscriber wide area network wireless telephone 88 is shown. The wide area network wireless telephone 88 includes a controller 180 operating a CSS application 174', the subscriber contact directory application 178, a wireless communication application 194, and applicable drivers 196 for a plurality of peripheral controllers. The application controller 180 is interconnected to the plurality of peripheral controllers by an internal bus 186. The peripheral controllers include a wide area network RF circuit 182, a voice system 197, a display controller 184, a touch panel controller 185, a key switch controller 193, a communication controller 188, and a power management system 190.

The wide area network RF circuit 182 may be a circuit for transmitting and receiving signals from a wide area network service provider's medium under control of the wireless communication application 194. Exemplary wide area network service provider mediums include an analog or digital cellular or PCS telephone RF system.

The key switch controller 193 is coupled to the control buttons 195. The key switch controller 193 drives row and column signals to the control buttons 195 and, upon detecting a short between a row and a column indicating button activation, reports the activation to the application controller 180. The control buttons may be used by a subscriber for operating the wide area network wireless telephone 88 when uncoupled form the platform unit 52.

`The voice system 197 includes a speaker and a microphone. Under control of the wireless communication application 194, the voice system 197 may provide a subscriber voice interface for an audio session with a remote device over the wide area network service provider's medium.

The display controller 184 drives the display 90 using signals compatible with the resolution and color depth of the display 90. The display 90 may optionally be a touch panel display 90 and the touch panel controller 185 detects user activation of the touch panel 90.

The communication controller 188 may be a serial communication controller compatible with the communication controller 122 in the platform unit 52 such that data communication may occur between the platform unit 52 and the wide area network wireless telephone 88 when the wide area network communication device is operatively coupled to the platform unit 52.

The power management controller 190 operating with a battery pack 192, both of which may operate in a similar manner to the power management controller 170, and the battery pack 172 discussed with reference to Figure 5.

Similar to the subscriber data assistant 86 (Figure 5), when the wide area network wireless telephone 88 is coupled to the platform unit 52, the CSS application 174' provides for displaying multi-media communication management information under control the platform unit 52 and provides for multi-media communication directly between the platform unit and the wide area network service provider medium.

In addition the CSS application 174' may receive messages from the platform unit 52 which may be multi-media communication messages for communication over the wide area network service provider medium. Each message includes a tag that identifies the contents of the message. After receipt of a tagged message, the CSS application 174' may identify whether the message is for communication with the wide area network service provider medium or whether it is multi-media communication management information for display.

When the message is for communication with the wide area network service provider medium, the CSS application 174' reformats the message to a format

compatible with wide area network service provider medium transmission standards and transmit the message using the wide area network RF circuit 182.

The wide area network wireless telephone 88 may also receive signals from the wide area network service provider medium via the wide area network RF circuit 182. When received, the CSS application 174' reformats the messages into a plurality of tagged messages for communication to the platform unit 52 and send the tagged messages to the platform unit 52 via the communication controller 188.

Wireless Voice Handsets

Figure 7 shows a block diagram of an exemplary wireless voice handset 26. The wireless voice handset 26 includes a network circuit 278 and an application controller 250 that operates a CSS application 174", the subscriber contact directory application 178, a LAN communication application 252, and applicable drivers 254 for each of a plurality of peripheral controllers. The application controller 250 is interconnected by a bus 276 to the plurality of peripheral controllers which include a module controller 258, a display driver 260, a touch panel driver 261, a key switch controller 264, and a power management circuit 270.

The module controller 258 operatively couples the network circuit 278 to the application controller 250 such that the wireless voice handset 26 may communicate with the control unit 12 over the wireless LAN 22 (both of Figure 1). In the exemplary embodiment, the module controller 258 may be a PCMCIA controller circuit and the network circuit 278 is configured as a PCMCIA card that coupled to the module controller 258 through a PCMCIA connector 272. The LAN communication application 252 operates the network circuit 278 for communicating with the control unit 12 using appropriate wireless signaling protocols.

The key switch controller 264 is coupled to the control buttons 266. The key switch controller 264 drives row and column signals to the control buttons 266 and, upon detecting a short between a row and a column indicating button activation, reports the activation to the controller 250. The control buttons may be used by a subscriber for operating the wireless voice handset 26 when uncoupled form the platform unit 52.

The display controller 260 drives the display 90 (optionally a touch panel

display 90) using signals compatible with the resolution and color depth of the display 90. The touch panel controller 261 detects user activation of the touch panel display 90. The power management controller 270 operates in conjunction with a battery pack 268, both of which may operate in a similar manner to the power management controller 170, and the battery pack 172 discussed with reference to Figure 5.

When the wireless voice handset 26 is coupled to the platform unit 52, the CSS application 174" provides for displaying multi-media communication management information under control the platform unit 52. Additionally, the CSS application 174" may receive multi-media communication management information content messages and control messages directly from the control unit 12 via the wireless network 22. After receipt of the tagged messages from either the platform unit 52 or the control unit 12, the CSS application 174" builds a document to display the communication management information represented by the tagged content messages in accordance with display layout control messages that are compatible with the size, resolution, and color depth of the touch panel display 90. The display document is then displayed on the touch panel display 90.

Session Control Server

Referring to Figure 4 in conjunction with the tables of Figures 8a-8e, exemplary operation of the session management server 230 providing multi-media communication management in accordance with the present invention is shown.

The session control server 230 operates as a multi-tasking event driven state machine. A separate state machine is operated by the session control server 230 for each of the local communication devices 20 (Figure 1). During operation of each state machine, the session control server 230 receives event signals from each of the voice server 218, the messaging client 228, the packet switched voice gateway 232, the multimedia communication service provider medium 18, and the particular local communication device 20 for which the state machine is operated. Each state machine includes multiple processing states and within each processing state there are a plurality of events that may be detected by the session control server 230. Each event has a processing state dependent processing sequence

that is processed by the session control server 230.

The table of Figure 8a represents a start up state. In the start up state, the session control server 230 is waiting for an open session request from a new communication space station 24 on a predetermine port. When a communication space station 24 has just operatively coupled to the local area network 22, obtained a network address from the network address server 220, and is ready to operate, it is programmed to send an open session request to a predetermined network address (matching that of the session control server 230) on the predetermined port. Event 300 represents receipt of an open session request form the communication space station 24. In response, various steps are performed to initiate management of multi-media communications of the communication space station 24 that include: providing logon scripts to the communication space station 24; obtaining an interface configuration of the communication space station 24; providing main menu display content and main menu layout control messages to the communication space station 24 that are compatible with the particular display (if any) that is included in the interface configuration of the communication space station 24; and transitioning to a main menu state 304 as represented by Figure 8b.

When in the main menu state 304, the session control server 230 is waiting for one of a plurality of events to occur that may include event 302 that represents a message indicating subscriber selection of a menu choice from the main menu, event 308 that represents a message from the communication space station 24 indicating that a subscriber device 50 (Figure 1) has been operatively coupled to, and is ready to be served by, the communication space station 24, and event 310 that represents a message indicating subscriber activation of the help control 105 (Figure 2).

In response to event 302, the session control server 230 transitions to a state corresponding to the selected menu choice. In response to event 308, the session control server performs a plurality of steps to associate the subscriber device 50 with the communication space station 24.

Messages representing extraction control scripts may be sent to the subscriber station 24 which provide for the subscriber station to obtain identification

information associated with the subscriber device 50 and send the identification information to the session control server 230.

With the subscriber device 50 identified, the session control server 230 may update the current network location table 233 by associating the network address of the communication space station 24 with subscriber device 50 (or more specifically with the subscriber identifier associated with the subscriber device 50). Additionally, with the subscriber device identifier, the session control server 230 may synchronize the subscriber contact directory database 234 with subscriber contact files on the subscriber device 50. Messages are received from the subscriber device 50 to provide for receiving subscriber contact files to update the subscriber contact directory database 234 with any edits to the subscriber contact files that may have been made when the subscriber device 50 was uncoupled from the communication space station 24. Subscriber contact information from the subscriber contact director 234 may be communicated to the subscriber device 50 to update the subscriber contact files stored on the subscriber device 50. Main menu display content messages and main menu display layout control messages that are compatible with display 90 on the particular subscriber device 50 are sent to the communication space station 24 to effect the display of a main menu on the display 90. Further, in the event that the particular subscriber device 50 is a wide area network wireless telephone 88, the session control server 230 further queries the call forward file 245 to identify the network controller 522 (Figure 13) , the call forward command 524, and the designated telephone number 520 associated with the wide area network wireless telephone 88. The session control server 230 then establishes a communication session to the network controller 522 (using either the telephone number of the Internet address to contact the controller) through the multi media service provider medium. When the network controller 522 is identified by its Internet address, the session control server 230 may establish the communication session using TCP/IP protocols. When the network controller 522 is identified by telephone number, the session control server 230 may establish the communication session by dialing the telephone number through the packet voice gateway 232. After the communication session is established, the session control

server 230 delivers the call forward command 524 and the designated telephone number 520 to the network controller 522 through the communication session to effect forwarding of calls to the predetermined telephone number. After completion of these steps, the session control server 230 transitions to a subscriber device main menu state 316 as represented by Figure 8c.

In response to event 310, the session control server 230 provides control scripts to the subscriber station 24 to provide for the communication space station 24 to establish the appropriate audio session channels to the voice gateway 232 and for the voice gateway 232 to access the session control server 230 through the voice converter 218, and transitions to an audio help state wherein a subscriber is directed through a sequence of help menu choices by audio prompts initiated by the session control server 230.

When in the subscriber device main menu state 316 of Figure 8c, the session control server 230 is waiting for one of the events associated with the subscriber device main menu state that include event 312 that represents a message indicating subscriber selection of a menu choice from the subscriber device main menu, event 320 that represents a message indicating subscriber activation of the help control 105 (Figure 2), event 322 that represents a message indicating subscriber activation of the message control 78 (Figure 2), event 324 that represents a message indicating subscriber activation of the audio message control 76 (Figure 2), event 314 that represents a message indicating subscriber activation of the directory control 107 (Figure 2), and event 326 that represents a message indicating that the subscriber device 50 is no longer served by the communication space station 24.

In response to event 312, the session control server 230 transitions to a state corresponding to the selected menu choice. In response to event 320, the session control server 230 provides messages representing help menu display content and help menu display layout control in accordance with the parameters of the display 90 on the subscriber device 50 and then transitions to a graphic help state wherein the subscriber is directed through a sequence of graphic help menu choices through various levels of display menus provided to the communication

space station 24 through help menu display content messages and help menu display layout control messages. In response to events 322 or 324 the session control server 230 obtains messages associated with the subscriber device 50 from a remote messaging server coupled to the service provider medium, sort the messages in accordance with the message type selection, provide messages representing message list display content and message list display layout control in accordance with the parameters of the display 90 on the subscriber device 50, and then transition to a message list state 328 (Figure 8d). In response to event 314 the session control server 230 obtains subscriber contact information that corresponds with the subscriber device, provide the directory content and display layout control messages to the communication space station 24, and transition to a subscriber directory state 370 as represented by the table of Figure 8e.

In response to event 326 the control unit 12 determines if the subscriber device 50 is a wide are network telephone, if not, the control unit 12 transitions to the main menu state 304 (Figure 8b). However, if the subscriber device 50 is a wide area network wireless telephone 88, the session control server 230 queries the call forward file 245 to determine the network controller 522 associated with the wide area network wireless telephone 88 (again, either an IP address or a telephone number) and to determine a call forward deactivation command 526. The session control server 230 then establishes a session with the wide area network controller 522 and delivers the call forward deactivation command to effect the termination of call forwarding of incoming calls placed to the wide are network telephone 88.

When in the message list state 328 of Figure 8d, the session control server 230 is waiting for one of a plurality of events associated with the message list state 328 that include event 334 that represents a message indicating that the subscriber has activated a control to obtain an audio message from the list (either by touch panel activation or by buttons 92 of Figure 2), event 336 that represents a message indicating that the subscriber has activated a control to display a message from the list (either by touch panel activation of by buttons 92 of Figure 2), event 338 representing a message indicating that the subscriber has activated the print

control 80 (Figure 2), event 340 that represents a message indicating subscriber activation of the help control 105 (Figure 2), and event 342 that represents a message indicating that the subscriber device 50 is not longer served by the communication space station 24.

In response to event 334 the session control server 230 communicates the selected audio message files to the communication space station 24 and provides control scripts to the subscriber station 24 to provide for the subscriber station to output the message through the voice system 130. In response to event 336 the session control server 230 provides display content and display layout control that are compatible with parameters of the display 90 on the subscriber device 50 for display of the selected message and then transitions to a message display state. In response to event 338, the session control server 230 formats the selected message into a printer compatible file, sends the print file to a printer coupled to the network 22, and returns to the message list state 328. In response to event 340 the session control server 230 provides messages help menu display content and help menu display layout control messages in accordance with the parameters of the display 90 on the subscriber device 50 and then transitions to the graphic help state. In response to event 342 the control unit 12 determines if the subscriber device 50 is a wide area network wireless telephone 88, if not, the control unit 12 transitions to the main menu state 304 (Figure 8b). Again however, if the subscriber device 50 is a wide area network wireless telephone 88, the session control server 230 queries the call forward file 245 to determine the network controller 522 associated with the wide area network wireless telephone 88 (again, either an IP address or a telephone number) and to determine a call forward deactivation command 526. The session control server 230 then establishes a session with the wide area network controller 522 and delivers the call forward deactivation command to effect the termination of call forwarding of incoming calls placed to the wide are network telephone 88.

When in the subscriber directory state 370 the session control server 230 is waiting for an event associated with the subscriber directory state 370 which may include event 372 that represents receipt of a message representing a contact

selection that indicates that either an applicable portion of the touch panel was activated or a particular button 92 (Figure 2) was activated to indicate subscriber selection of a contact, event 374 that represents receipt of a message that indicates subscriber activation of the help control 105 (Figure 2), and event 378 that represents a message indicating that the subscriber device 50 is no longer served by the subscriber station 24.

In response to event 372, the session control manager 230 communicates a control script to the communication space station 24 that provides for the communication space station 24 to establish the appropriate audio session channels to the voice gateway 232 and for the voice gateway 232 to establish an appropriate audio session channel to a destination associated with the selected contact. The control script may include a telephone number from the subscriber contact directory database 234 associated with the contact. Following communication of the control script, the session control server 230 transitions to an audio session state.

In response to event 374, the session control server 230 provides messages representing help menu display content and layout control and then transition to the graphic help state. In response to event 378 the control unit 12 determines if the subscriber device 50 is a wide area network wireless telephone 88, if not, the control unit 12 transitions to the main menu state 304 (Figure 8b). However, if the subscriber device 50 is a wide area network wireless telephone 88, the session control server 230 queries the call forward file 245 to determine the network controller 522 associated with the wide area network wireless telephone 88 (again, either an IP address or a telephone number) and to determine a call forward deactivation command 526. The session control server 230 then establishes a session with the wide area network controller 522 and delivers the call forward deactivation command to effect the termination of call forwarding of incoming calls placed to the wide are network telephone 88.

CSS Application

In the exemplary embodiment, the CSS application 115 is an event driven state machine. Within each processing state various events that are generated by

one of the peripheral circuits may be detected by the CSS application 115 and, upon detecting an event, a certain string of processing steps that correspond to the particular event will be performed by the CSS application 115.

Referring to the tables of Figures 9 in conjunction with the block diagram of Figure 3, exemplary operational states of the CSS application 115 are shown.

The start up state 346 represents the state of operation of the communication space station 24 immediately after establishing a network connection with the control unit 22 via the network 22. Upon establishing a connection, event 366, the CSS application 115 initiates a session request to the session control server 230 on a predetermined port. Event 368 represents confirmation of the session from the session control server 230 and receipt of the logon script from the session control server 230. In response to event 368, the subscriber device 50 processes the script which may include detecting the interface configuration of the communication space station 24, providing the interface configuration to the session control server 230, and transitioning to the base state 344.

The base state 334 represents the CSS application 115 waiting for an event signal from one of the peripheral devices which may include event 354 that represents subscriber touch panel activation, event 356 that represents subscriber activation of one of the control buttons, event 358 that represents receipt of display content and display layout control messages from the control unit 12, event 360 that represents receipt of a message comprising a processing script from the control unit 12, event 362 that represents a wide area network wireless telephone signal through a wide area network subscriber device 88 (Figure 1), event 364 that represents detecting a subscriber device 50 being coupled to the communication space station 24, event 350 that represents receipt of a message from the control unit 12 directed to the subscriber device 50, and event 352 that represents receipt of a message from the subscriber device 50 directed to the control unit 12.

In response to event 356, the CSS application 115 provides a message indicating the touch panel activation event to the session control server 230. In response to event 358, the CSS application 115 provides a message indicating

activation of the particular control button to both the packet voice application 113 and the session control server 230. In response to event 358, the CSS application 115 either updates the display 72 on the touch panel unit 60b (both of Figure 2) via the touch panel controller 128 or provides the messages representing the display content and the display layout control to the subscriber device 50 via the communication controller 122 for the subscriber device 50 to update its own display. In response to event 360, the subscriber device 50 processes the script as provided including interfacing with any of the peripheral devices as required by the script. For example, the extraction control script received from the session control server 230 may require interrogating the subscriber device 50 for identity information and providing a message representing such identification information to the session control server 230. In response to event 362, the subscriber device 50 may enter a wide area network communication state wherein it relays a digital representation of voice signals between the voice system 130 and a wide area network subscriber device 88 such that a voice conversation may take through the wide area network. In response to event 364, the communication space station 24 may send a message indicating that a subscriber device 50 is being initialized by the communication space station 24 (which corresponds to event 308 of Figure 8b) and then return to the base state 344. In response to event 350, the CSS application 115 provides the messages to the subscriber device 50 via the communication controller 122. In response to event 352, the CSS application 115 provides the messages to the session control server 230 via the network.

Packet Voice Application

The packet voice application 113 also operates as an event driven state machine. Again, each state includes a plurality of events that may occur when operating in the state and a sequence of steps that the packet voice application processes in response to the event. Referring to the tables of Figures 10a and 10b in conjunction with the block diagram of Figure 3, exemplary operational states of the packet voice application 113 are shown.

The stand by state 280 represents the packet voice application in an inactive mode waiting for an event that may include event 388 which represents receipt of

an audio session set up signal from the packet voice gateway 232, event 390 that represents receipt of a message from the CSS application 115 that represents activation of the on/off hook button (or switch) 109, and event 392 that represents receipt of a message from the CSS application 115 instructing the packet voice application 113 to set up an audio session with a specified destination.

In response to event 388, the packet voice application 113 transitions to a call signaling state 382 and report the transition to the CSS application 115. In response to event 390, the packet voice application 113 transitions to an off hook state 384 and report the transition to the CSS application 115. In response to event 392, the packet voice application 113 sends applicable call signaling messages to the packet voice gateway 232 to set up the audio session channel with the voice gateway 232 and provides for the voice gateway 232 to set up an appropriate audio session channel with the destination. The packet voice application 113 then transitions to the call signaling state 382, and reports the transition to the CSS application 115.

When in the call signaling state 382, the packet voice application 113 is providing a ring signal to the subscriber as either a ring signal to notify the subscriber of an incoming audio session or to notify the subscriber that an audio session set up signal has been sent to the packet voice gateway 232 and a destination device is "ringing" waiting for a remote party to effectively answer the call. During the ringing state 382 the packet voice application 113 may detect events such as event 394 that represents receipt of a message that represents activation of the on/off hook button 109 (Figure 2), event 396 that represents termination of call signaling by the packet voice gateway 232, event 398 that represents receipt of a ready for audio session signal from the packet voice gateway 232 if the packet voice application 113 is ringing to notify the subscriber that a remote device is ringing.

In response to either event 394 (and event 396 if the communication space station 24 is currently off hook), the packet voice application 113 returns to the standby state 380 and reports the state transition to the CSS application 115. In response to event 398 (and event 396 if the communication space station 24 is

current on hook) the packet voice application 113 transitions to an audio session state 386 and report he transition to the CSS application 115.

When in the off hook state 384, the packet voice application 113 may be generating a dial tone through the voice system 130 as a prompt for the subscriber to use the keypad to enter a telephone number. During the off hook state 384, the packet voice application 113 may accept events such as event 400 that represents receipt of a message that represents key pad activation, event 402 that represents validation of a number sequence as a complete telephone number that can be used to set up an audio session, and event 404 that represents receipt of a message that represents activation of the on/off hook button 109 (Figure 2).

In response event 400 the packet voice application 113 generates a DTMF tone through the voice system 130 to provide the subscriber with audio feedback and store the numeral as part of the sequence for validation. In response to event 402, the packet voice application 113 initiates call signaling to the packet voice gateway 232 utilizing the validated number as the destination, transitions to the call signaling state 382, and reports the transition to the CSS application 115. In response to event 404, the packet voice application 113 transitions to the standby state 380 and reports the transition to the CSS application 115.

When in the audio session state 386 the packet voice application 113 is relaying messages representing a real time audio dialog between the voice system 130 and the packet voice gateway 232. When in the audio session state 386, the packet voice application 113 may accept events such as event 406 that represents termination of the audio session by the packet voice gateway 232, event 408 that represents receipt of a message that represents subscriber activation of a keypad numeral, and event 410 that represents receipt of a message that represents activation of the on/off hook button 109 (Figure 2).

In response to event 406, the packet voice application 113 returns to the off hook state and reports the transition to the CSS application. In response to event 408, the packet voice application 113 generates a DTMF tone in the audio session signals to the packet voice gateway 232. In response to event 410, the packet voice application 113 returns to the stand by state 380 and reports the state

transition to the CSS application 115.

It should be appreciated that the systems and methods of the present invention provide for the communication and control of multi-media messages by a central control unit and a plurality of space station communication devices operating under the control of the control unit. This coordinated and integrated system architecture enables the space station communication device to merge the functionality and internal data of various portable subscriber devices into the space station communication device, to direct the functionality and data of the space station communication device to a selected one of the portable subscriber devices, and to provide the subscriber with a simple subscriber interface.

Although the invention has been shown and described with respect to certain preferred embodiments, it is obvious that equivalents and modifications will occur to others skilled in the art upon the reading and understanding of the specification. For example, the above described processing states, events, and processing steps for both the communication space station 24 and the session control server 230 are exemplary states only for demonstrating operation and are not intended to limit the scope of the present invention. It is envisioned that after reading and understanding the present invention those skilled in the art may envision other processing states, events, and processing steps to further the objectives of the modular multi-media communication management system of the present invention. The present invention includes all such equivalents and modifications, and is limited only by the scope of the following claims.